Space Weather Technical Forecast

Issued on Wednesday, 23 March 2022 at 00:48 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of Minor Geomagnetic Storm G1 to end current UTC working week.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares, peaking at C7 at 22/1242 UTC, which appears to have originated from a sunspot region, which is currently rotating around from the northeast limb. There are currently two numbered sunspot regions on the visible disc, AR2972, which is a Dro/Beta, although is showing signs of decay and fading of its spots. AR2974 is newly numbered in the southeast, which appears to complex and is showing some growth in its trailing spots. This sunspot region recently produced a minor C-class flare. There are two un-numbered sunspot regions on the disc, one in the southwest, which is currently classified as a Cro/Beta, and the second is located in the northeast, which is a small and simple Axx/Alpha

A prominence was seen to erupt off the northeast limb of the disc around 22/1700UTC, which is yet to be analysed, although given its location is unlikely to be Earth-directed.

No Earth-directed CMEs were observed in coronagraph imagery during the 24 hour period.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was mostly at background levels throughout the period, although with an unexpected increase to slightly elevated levels, and a peak of 450km/s at 22/1258 UTC, before declining back to a slow-ambient regime. This was probably a coronal hole(s) influence, either CH66/- or possibly CH67/+, although exact source is unclear. Density was mostly above average, peaking at 34ppcc, but briefly fell below average, in tandem with the aforementioned increase in solar winds. Phi angle was mostly positive (away from the sun), with brief orientations to negative (towards the sun), which may hint towards CH66/- influencing the brief enhancement in the above solar wind parameters. The IMF peaked at 11nT, with a north-south component range between -6 and +8nT and a somewhat erratic tendency between these limits. Geomagnetic activity as a result of the above solar parameters was mostly Quiet (Kp1-2), with Unsettled (Kp 3) intervals at 22/0300-0600 UTC and 22/1800-2100 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 were at background levels. The high energy electron flux (greater than 2 MeV) has been at Normal Background levels, and the 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, on a steady trend. Observed fluence at 23/0000UTC was 1.42e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to continue Very Low or Low, with a daily Slight Chance of M-class flares that may increase slightly with time as further regions appear from over the eastern solar horizon.

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Solar Wind / Geomagnetic Activity: There is one possible Earth-directed CME in the forecast, potentially giving Earth a glancing blow on late Day 2 (24 March). There is also one non-persistent coronal hole fast wind due, most likely on Day 1 (23 March). Separately, these events are not likely to be significant, however they may combine to give a Slight Chance of G1/Minor Storm on Day 2 (24 March), with this risk further decreasing from Day 3 (25 March). Geomagnetic activity should otherwise be mainly Quiet throughout the period.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels throughout the forecast period.
The high energy (greater than 2 MeV) electron flux is currently at Normal Background levels, and is unlikely to increase in the near-term. A rise in flux and 24-hour integrated fluence levels is possible later in the period after the potential CME and coronal hole fast wind arrivals, but this is low confidence. Fluence levels are most likely to stay well below the Active (1e8 integrated pfu) threshold throughout.

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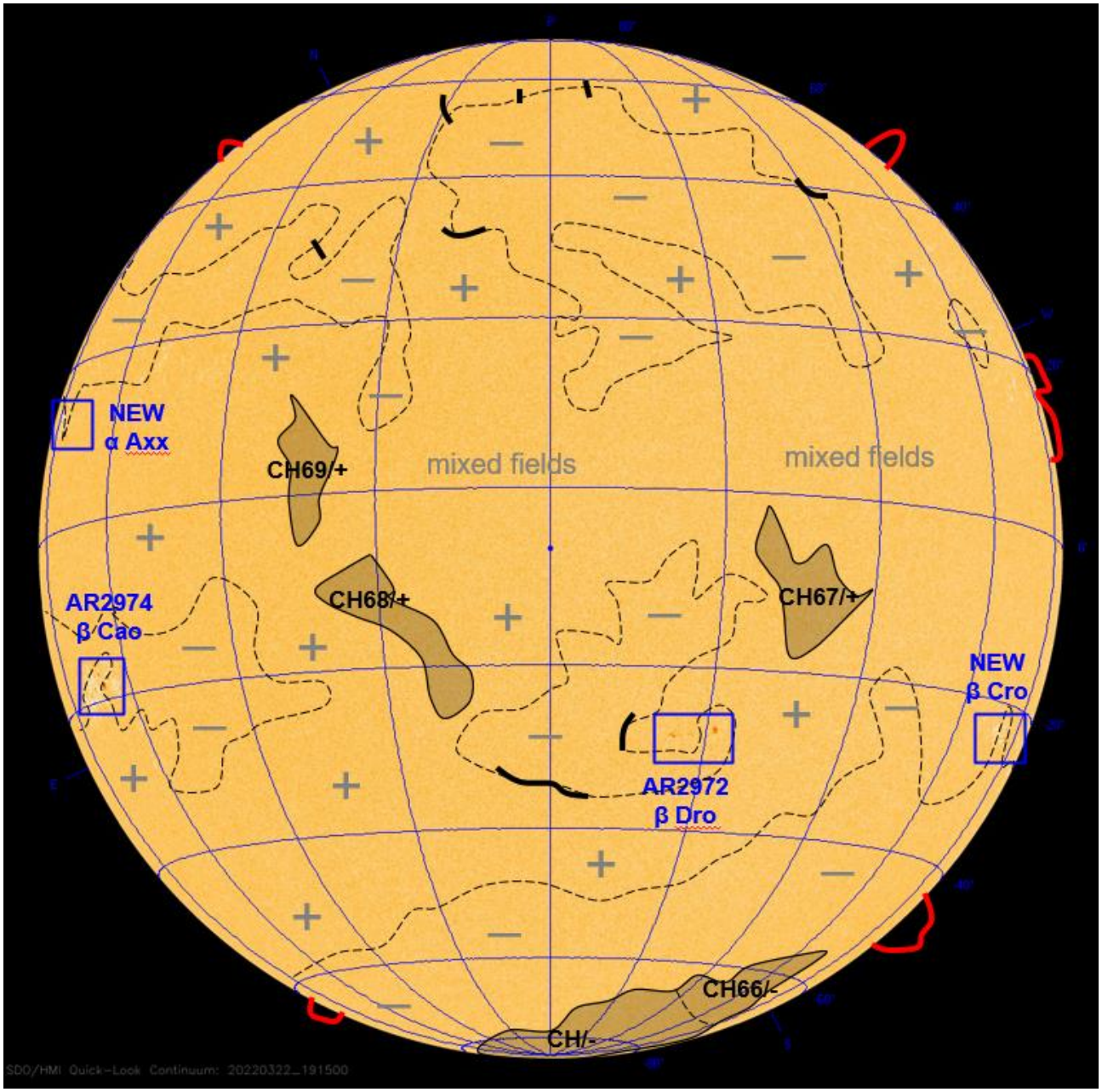
Figure 1. Solar Analysis Valid 22/1915UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Latest measurements from L1 suggest that a fast wind from a minor coronal hole may have arrived at Earth earlier in the UTC day of 22 March. The phi angle was mostly positive (away from the sun), with brief orientations to negative (towards the sun), which occurred in tandem with the fluctuations in the solar wind parameters (wind and density), which may suggest influence from CH66/-, which is a minor northward extension from the southern crown CH.
This is not likely to be impactful in terms of geomagnetism, perhaps offering a risk of Active Kp4 intervals early on Day 1 (23 March).

The forecast is otherwise unaltered. There is one possible Earth directed CME in the forecast, associated with the 20/0745UTC C4.6 flare which emerged from the plage remnant of Ex-2971 in the northeast quadrant. This has been assessed and there is a slight chance of a glancing blow at Earth on day 2 (24 March), probably late in the UTC day. No other CMEs feature in the forecast.

There is also one non-persistent coronal hole high speed stream due in the period, most likely on Day 1 (23 March) - from CH67/+ west of centre disc. This is both small and of positive polarity, and effects are likely to be muted as positive coronal holes are not favoured for a geomagnetic response at this time of year. However, the combination of the possible CME and coronal hole fast wind may give a slightly enhanced response. STEREO-A data appears to be polluted by a passing transient, but so far has failed to hint at the expected character of CH67.
Geomagnetic activity is expected to be mainly Quiet through much of the period, but with an increase possible on Day 2 (24 March), giving a Slight Chance of G1/Minor Storm interval.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
20/03/2022 22:40	Partial	Plage from Ex-2971	N09 E020	210km/s	24/2300UTC	Slow CME directed towards NE following C4 flare. Most ejecta directed NE of Sun-e

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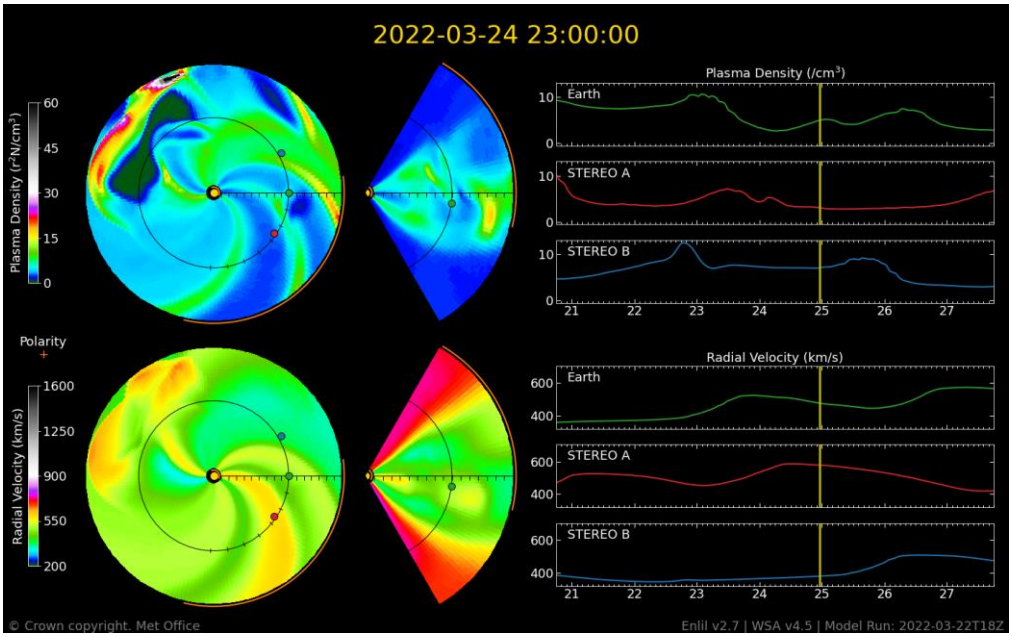
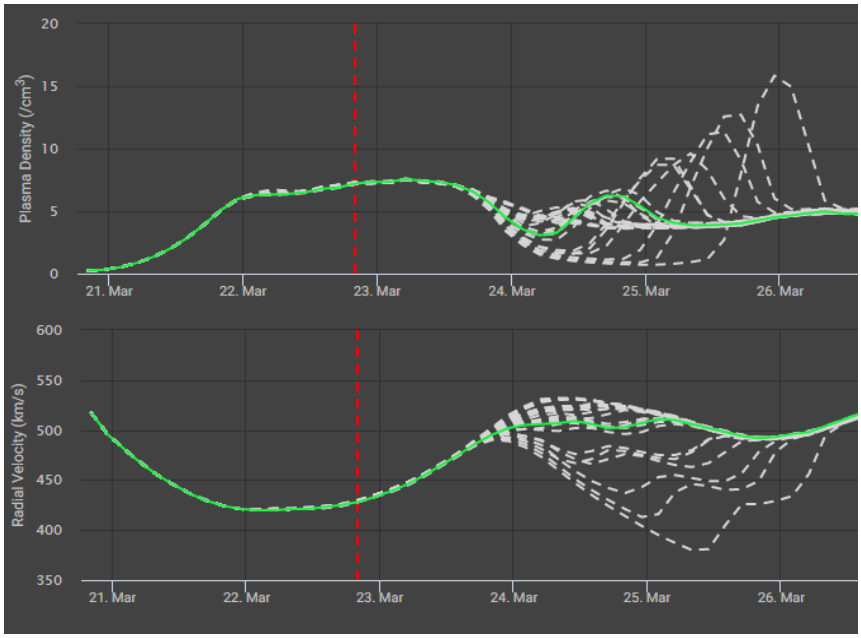
Figure 2: Latest MOSWOC Enlil model run (top), which shows a minor glancing blow from a weak CME late on Day 2 (24 March) possibly early Day 3 (25 March) – see ensemble (bottom).





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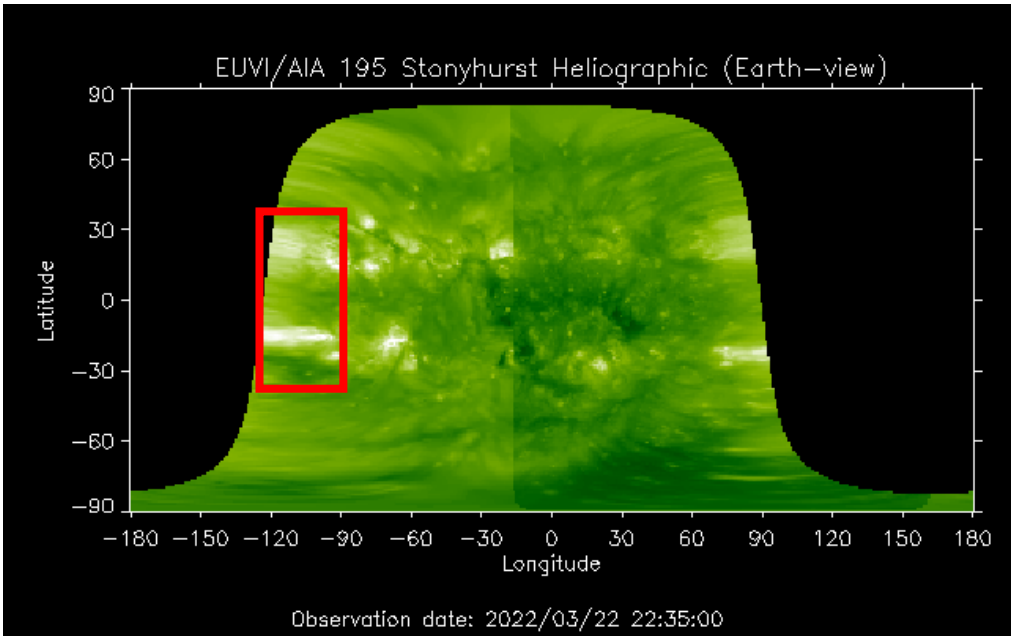
Radio Blackouts - X-Ray Flares:
Solar activity has been Low over the past 24 hours, with occasional C-class flares, peaking at C7 at 22/1242 UTC, which appears to have originated from a sunspot region, which is currently rotating around from the east limb.

The daily probability of M-class flares is judged at a Slight Chance (10%) throughout, largely as a result of the appearance of newly-numbered AR2974 in the southeastern quadrant, which is beginning to show some flaring activity, but only minor C-class flares at present.

There are further potential new sunspot regions due to rotate onto the visible disc in the next couple of days, however their respective contributions to any increase in flare activity will be more fully accounted for when and if they appear on the Earth-facing side of the disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: EUVI/AIA 195 Angstroms, shows possible bright flux regions on the far-side, approaching the east limb, likely to rotate onto the visible disc in the coming days.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is expected to remain at background levels throughout the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

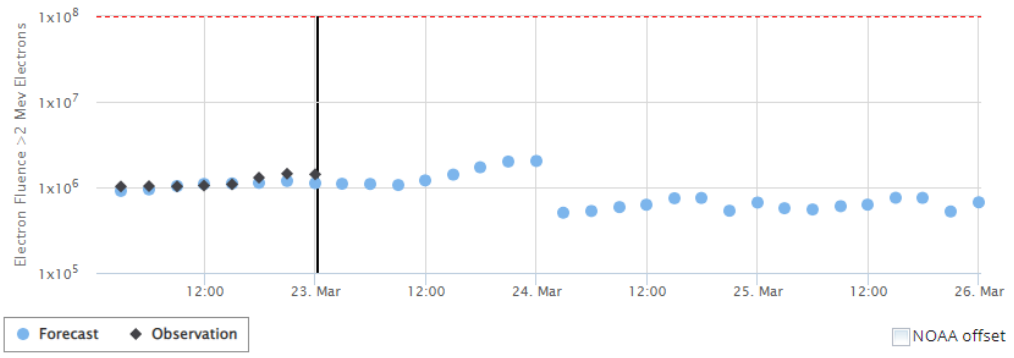
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at Normal Background levels, with any significant enhancement in the near-term unlikely.

However, due to the uncertainty with waning effects of any coronal hole(s) influence, there is a slight chance of some enhancement from Day 2 (24 March). There is unlikely to be any significant geomagnetic response from the weak CH influence, so unlikely to raise electron levels enough to reach the Active (1e8 integrated pfu) fluence threshold in the forecast period. The general trend on MOSWOC REFM is currently flat and well below Active, which is accepted.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM electron fluence – observations and forecast – shows a steady trend.



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